An early assessment of the impact of COVID-19 on air transport

An early assessment of the impact of COVID-19 on air transport: just another crisis or the end of aviation as we know it?

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Abstract
Against the dramatic context of the Covid-19 pandemic, we contribute to the academic and policy discussion by summarizing the main conclusions of a series of in-depth interviews with senior industry executives. Instead of discussing specific recovery scenarios, the focus is placed on identifying aspects that can structurally redefine the aviation industry in the medium and long term for both passenger and cargo traffic, particularly in regards to the concentration of supply, traffic resilience, passenger behaviour, health regulations and business ethics. Since the views of senior stakeholders might change as the crisis evolves, keeping a record of their early assessments represents a valuable reference for future analysis.

Keywords
Covid-19; Coronavirus; Aviation; Crisis Recovery; Business Ethics.

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1. Introduction

Air traffic is vulnerable to external factors, such as oil crises, natural disasters, armed conflicts, terrorist attacks, economic recessions and disease outbreaks. These directly impact air traffic numbers as a result of flight cancellations, aircraft groundings, travel bans and border closures, leading to fewer airline passengers, lower load factors and yields, while airports lose non-aeronautical revenues. Before Covid-19, the most important disease outbreak in terms of impact on air traffic was SARS in 2003. According to IATA (IATA, 2020a), in May 2003, at the height of the SARS outbreak, monthly revenue passenger kilometres (RPKs) of Asia-Pacific airlines were 35% lower than their pre-crisis levels. Covid-19 has gone well beyond these levels and is currently taking the aviation industry into uncharted territory. As of 24 March 2020, the air transport markets with severe restrictions (i.e., quarantine for arriving passengers, partial travel bans, and border closures) account for 98% of the global passenger revenues. Many airlines have been brought to a complete stop and, to make matters worse, the provisionally-observed recovery pattern for Covid-19 is turning out to be slower than the V-shaped pattern observed in 2003. (See Figure 1).

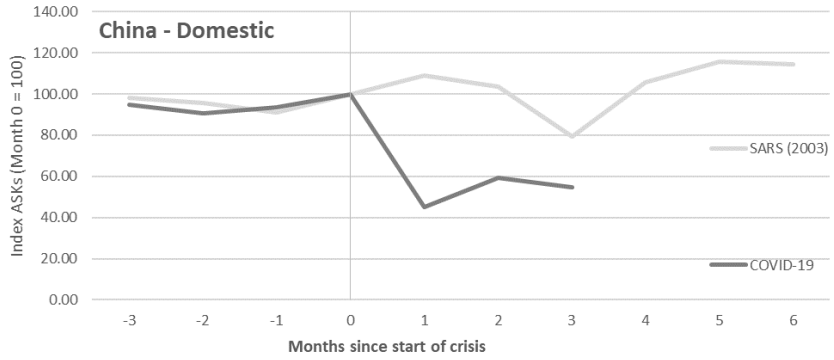


Figure 1. SARS vs Covid-19 outbreak available seat kilometres (ASKs) evolution in the Chinese domestic market.
Source: analysis based on OAG Schedules.

In that regard, the Covid-19 crisis has quickly spread globally and different industry organisations have tried to come up forecasts. Airports Council International (ACI) predicted that Covid-19 can wipe out two-fifths of passenger traffic and half of airport revenues in 2020, s(ACI, 2020). The International Civil Aviation Organisation (ICAO) estimates that during the first half of 2020, compared to their original forecast, there will be an overall reduction of 47% to 58% of seats offered by airlines, 503 to 607 million passengers, and a potential loss of gross of operating revenues of airlines of 112 to 135 billion USD (ICAO, 2020). The International Air Transport Association (IATA) predicts a very slow growth for the second half of 2020, which would be translated in an overall reduction for 2020 of 48% in terms of Revenue-Passenger-Kilometres (RPKs) and 55% in passenger revenues. Consultancy firms have come up with recovery forecasts. For example, the Boston Consulting Group defined five demand recovery scenarios, with times to recovery between 3 months and 18 months (BSG, 2020). Still, all these forecasts, which, in normal circumstances, are traditionally considered as unreliable (de Neufville and Odoni, 2003), become even more so amidst an ongoing crisis dominated by uncertainty at all levels.

Early aviation-themed academic contributions related to Covid-19 have focused on how aviation networks can contribute to global virus propagation (e.g., Wu et al., 2020; Boldog et al., 2020; Adiga et al., 2020). For example, Chinazzi et al. (2020) conclude that travel restrictions are more effective if combined with social distancing policies to curb local transmission. Nikolaou and Dimitriou (2020) identify the critical airports for controlling global infectious disease outbreaks in Europe by integrating an epidemiological model with the structure of airline networks. Others have tried to estimate the outbreak size in a given country, for example, Tuite et al., (2020) for Italy and Zhuang et al. (2020) for Iran.

Our paper does not deal with the epidemiological aspects of the current pandemic but, instead, we focus the medium- and long-term impacts of Covid-19 on the aviation industry. We do that by discussing the results of a series of in-depth interviews with senior industry executives. These interviews were conducted during the first weeks of the crisis, as the governments all over the world started to implement widespread lockdown measures. It was a period of extreme uncertainty, hence our analysis does not deal with specific recovery scenarios. Instead, the focus is placed on identifying aspects that can structurally redefine the aviation industry in the medium and long term for both passenger and cargo traffic, particularly in regards to the supply, demand, regulations and business ethics. Since the views of senior stakeholders might change as the crisis evolves, keeping a record of their early assessments represents a valuable reference for future analysis.

The remainder of this paper is structured as follows: in Section 2 we describe our methodology to carry out the interviews. Section 3 provides an overall picture of the major traffic impacts of Covid-19 during the first four months of 2020. Section 4 discusses the interview results in relation to the supply-side on the industry. Section 5 examines the long-term changes of in demand and passenger behaviour. Section 6 deals with regulatory aspects. Section 7 reviews the major uncertainties identified by the experts. Section 8 discusses some of the opportunities identified by our interviewees to transform the aviation industry and discusses some ethical aspects. Finally, Section 9 presents the conclusions.

2. Methodology

The empirical work is based on three main sources of information. Firstly, flight supply data has obtained from the Schedules dataset by OAG (Official Airline Guide), which provides supply information on a diverse number of variables for each scheduled flight, including origin and destination airport, time of departure and arrival, number of seats supplied, aircraft type, and day of operation. We include all global capacity data for the first four months of 2020 (January to April) in order to calculate year-on-year changes with respect to the equivalent dates in 2019. We acknowledge the limitations of using capacity data in this analysis, given the fact that, for different reasons, many airlines were flying empty aircraft or with very load factors before grounding most of their fleet. Another limitation could have been the capacity of OAG to update their datasets to keep up with the unprecedented market changes. However, this risk has been minimised by the data provider, which has taken several steps to ensure that the schedules dataset is up to date.[1]

Air freight data is from CLIVE Data Services and covers the first three months of 2020. CLIVE consolidates data shared by international airlines and it is widely regarded as the provider with

[1] See message from the CEO of OAG on how the schedules dataset was kept updated on a daily base: https://www.oag.com/blog/oag-covid-19-a-message-from-our-ceo-phil-callow

the earliest up-to-date figures for global air freight markets. The dataset contains information on chargeable weight, air freight capacity and dynamic load factors.

Thirdly, 16 senior aviation executives were interviewed between 19 March 2020 and 17 April 2020. Although the interviews were selective, we aimed for a diverse cohort (Table 1). Regarding the airline sector, we interviewed managers of a major network carrier, a large low-cost carrier, a regional airline, an airline association, a pilot union, an aviation insurance broker and an aircraft lessor. For the airport sector, we interviewed managers of a large hub airport, a medium size airport and a regional airport, as well as of an airport investing firm. Finally, we also interviewed senior leaders from other organisations, namely consultancies and a data company. We need to acknowledge a possible geographical bias, as most of the interviewees belong to European organisations. This is partially mitigated by the seniority of the interviewees and the global scope of the subject at hand. The names are not be revealed in order to encourage free expression of opinions and to ensure their anonymity (Taylor and Bogdan, 1986). Semi-structured interviews were deemed the most appropriate method as they allow the respondents to introduce new, unpredictable issues and interviewer to follow up topics more flexibly. Semi-structured interviewing was conversation-like, focusing on three main aspects, the long-term consequences on the supply-side, the potential long-term changes on passenger behaviour, and the possible long-term regulatory impacts.

Table 1. List of interviewees.

Airline industry	**Position**
Airline insurance broker	Country Director
Aircraft lessor	Vice President
Country airline association	President
European regional airline	CEO
Major European low-cost carrier	C-level
Airline pilot union	Head of union
Major European network carrier	Former VP for Cargo

Airport industry	**Position**
Major European hub airport	Head of strategy
Medium size European airport with 10-20 million passengers	Director, CEO
Regional European airport with 200-500K passengers	Deputy Managing Director
Airport investor	Senior Manager

Others	**Position**
Large aviation services consultancy	Head of Sustainability
Business travel agency association	Country Director
Large Asian aviation consultancy	CEO
Boutique Consultancy Firm from Latin America	CEO
Data Company	Managing Director

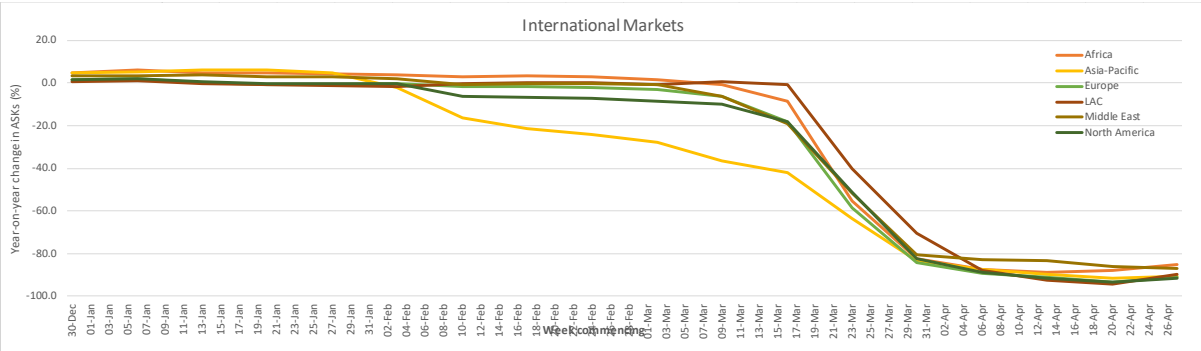
3. Impact of Covid-19 on global traffic

This section presents some traffic figures to frame the discussion of the interview results. One of the characteristics of the Covid-19 outbreak has been the quick geographical spread of the virus (Lai et al., 2020), with an initial manifestation in Asia and a lagged response in the rest of the world's regions (Figures 2, 3 and 4). Airlines tried to operate a normal schedule until they were prevented by drastic mobility measures. These translated into sudden drops in flight supply during March 2020, especially from the week commencing March 16th, when

lockdowns and border closures started to be dominant across Europe and America[2]. The response of airlines was, therefore, related to the reaction of governments to the outbreak. Also, many airlines operating in congested, slot-regulated airports continued flying empty or almost empty aircrafts with the objective of avoiding losing their slots for the next season (CNN, 2020).

As a result of border closures and travel bans, the impact has been stronger in international markets (Figure 2) than in domestic markets (Figure 3). However, it is interesting to see, that in the week commencing March 9th, the supply of international seats increased in Latin America, most probably due to the repatriation of passengers in the advent of the following week's lockdowns. Indeed, looking at region-to-region air traffic corridors (Figure 4), significant temporal differences in the traffic reduction can be identified.[3] As a result of the strong business connections between China and Africa, the first corridor to reduce the year-on-year ASKs was the Asia Pacific-Africa in the week commencing February 3rd. Then, in the week commencing February 10th, the rest of the Asia Pacific corridors with North America, Europe and the Middle East followed. The remaining corridors did not start experiencing significant loses until March. Massive worldwide capacity reductions finally took place in the week commencing March 23rd and continued all through April.

Domestic markets experienced a slower and more heterogenous reaction, since they have been the refuge of airlines to keep some level of activity, just before the widespread grounding of the fleet in late March. Only the domestic markets of North America and the Middle East have kept a significant level of activity, since their national lockdowns have been later and uneven across states and countries respectively. Interestingly, Figure 2 shows that the partial recovery of the Asia Pacific domestic markets during March (fuelled by China's recovery), turned into a double-dip in April as other Asian countries experienced drops in domestic traffic in consonance with the global trend during the same period.

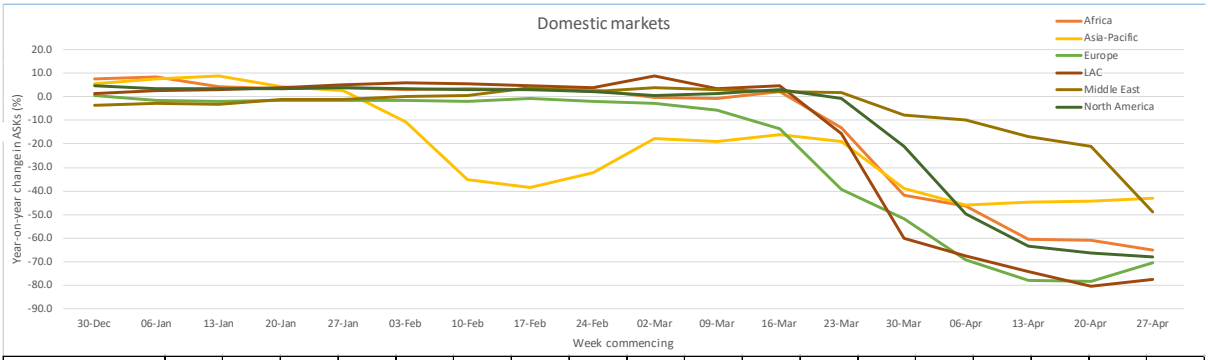


Region\Week starting	30-Dec	06-Jan	13-Jan	20-Jan	27-Jan	03-Feb	10-Feb	17-Feb	24-Feb	02-Mar	09-Mar	16-Mar	23-Mar	30-Mar	06-Apr	13-Apr	20-Apr	27-Apr
Africa	4.7	6.2	4.5	4.6	4.2	3.7	2.7	3.4	2.9	1.6	-0.7	-8.7	-55.2	-82.3	-87.4	-88.7	-88.0	-85.2
Asia-Pacific	4.9	5.0	5.9	6.1	4.6	-2.1	-16.5	-21.6	-24.0	-28.0	-36.4	-41.8	-63.4	-83.1	-87.4	-89.7	-91.6	-90.6
Europe	1.7	1.8	-0.1	-0.7	-0.6	-0.6	-1.9	-1.9	-2.3	-3.0	-6.1	-18.3	-58.5	-84.2	-89.4	-90.9	-93.5	-91.0
LAC	0.6	1.1	-0.2	-1.0	-1.3	-1.5	-0.5	-0.1	0.1	-0.6	0.6	-0.8	-40.4	-70.3	-87.8	-92.6	-94.3	-89.9
Middle East	3.2	3.4	3.7	2.8	2.9	2.0	-0.6	-0.3	-0.2	-1.0	-6.3	-19.2	-51.6	-80.4	-83.0	-83.3	-85.8	-86.8
North America	1.5	2.1	0.6	-0.4	-0.1	-0.3	-6.1	-6.9	-7.3	-8.4	-9.9	-18.1	-51.4	-82.2	-88.6	-91.4	-93.2	-91.4
Total	2.9	3.2	2.6	2.2	1.7	-0.7	-7.0	-8.6	-9.5	-11.3	-15.7	-24.2	-56.8	-82.1	-87.9	-89.9	-92.0	-90.2

Figure 2. Year-on-year change in ASKs by region, international markets, Jan-Apr 2020 vs 2019
Source: analysis based on OAG.

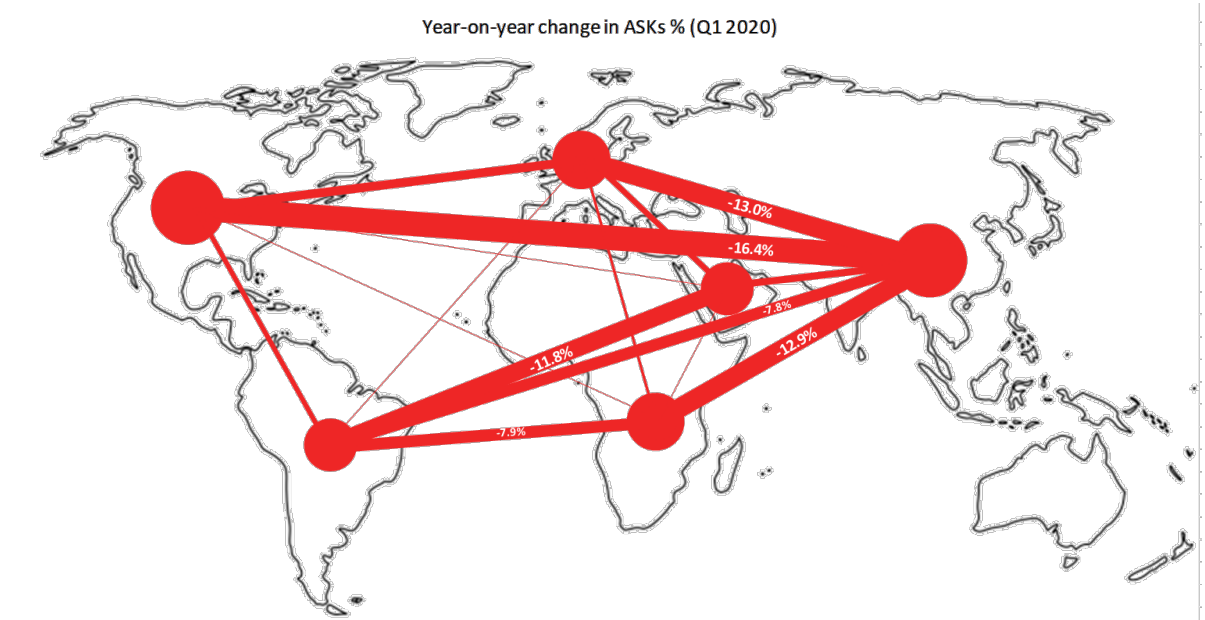
[2] See World Health Organization regular Coronavirus disease situation reports at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/

[3] We need to leave aside the Latin American and Caribbean (LAC)-Middle East, the LAC-Asia Pacific and the LAC-North America corridors, which present structural drops of supply during the whole period of analysis due to market dynamics and airline strategies (find reasons and reference).



Region\Week starting	30-Dec	06-Jan	13-Jan	20-Jan	27-Jan	03-Feb	10-Feb	17-Feb	24-Feb	02-Mar	09-Mar	16-Mar	23-Mar	30-Mar	06-Apr	13-Apr	20-Apr	27-Apr
Africa	7.6	8.3	4.2	3.5	3.7	3.2	3.5	3.0	2.9	-0.4	-0.8	2.2	-13.2	-41.9	-46.6	-60.4	-61.1	-65.1
Asia-Pacific	5.5	7.5	8.7	4.2	2.8	-10.5	-35.2	-38.5	-32.3	-17.9	-19.0	-15.9	-19.0	-39.1	-46.2	-44.9	-44.5	-43.0
Europe	0.6	-1.4	-1.8	-1.5	-1.4	-1.7	-1.7	-0.6	-1.9	-2.7	-5.5	-13.8	-39.2	-51.9	-69.3	-78.0	-78.6	-70.3
LAC	1.5	2.5	2.9	3.9	5.3	6.0	5.5	4.5	4.0	8.8	3.5	4.5	-15.7	-59.9	-67.8	-74.3	-80.6	-77.6
Middle East	-3.6	-2.7	-3.1	-1.0	-1.1	0.1	0.8	3.8	2.0	3.8	3.0	2.4	1.7	-7.7	-10.0	-16.9	-20.8	-49.0
North America	4.6	3.5	3.3	3.4	4.0	3.6	3.0	2.9	2.1	0.5	1.5	3.2	-0.7	-21.0	-49.6	-63.2	-66.1	-68.1
Total	4.4	4.8	5.2	3.4	3.1	-2.9	-14.2	-15.3	-12.9	-6.8	-7.3	-5.8	-12.1	-33.6	-50.4	-56.7	-58.4	-58.0

Figure 3. Year-on-year change in ASKs by region, domestic markets, Jan-Apr 2020 vs 2019.
Source: analysis based on OAG.



Corridor	30-Dec	06-Jan	13-Jan	20-Jan	27-Jan	03-Feb	10-Feb	17-Feb	24-Feb	02-Mar	09-Mar	16-Mar	23-Mar	Total	06-Apr	13-Apr	30-Mar	20-Apr	27-Apr
Asia-Pacific-North America	3.8	3.1	2.3	0.3	0.3	1.3	-18.9	-22.8	-24.6	-29.3	-35.0	-37.6	-56.9	-16.4	-85.1	-89.2	-88.6	-91.8	-88.7
Asia-Pacific-Europe	1.1	1.3	1.6	0.6	0.2	-0.7	-11.5	-15.9	-16.8	-19.0	-24.6	-31.7	-53.7	-13.0	-76.8	-86.2	-88.0	-90.3	-87.0
Africa-Asia-Pacific	7.5	8.5	7.4	6.4	5.4	-6.0	-19.7	-19.7	-19.2	-22.6	-27.9	-33.6	-61.1	-12.9	-95.7	-92.5	-93.6	-94.3	-89.0
LAC-Middle East	-13.5	-14.7	-11.1	-11.1	-11.1	-14.7	-12.0	-8.6	-13.5	-13.5	2.8	-4.2	-26.4	-11.8	-88.1	-85.4	-86.7	-85.8	-85.8
Africa-LAC	-4.5	-3.2	-1.0	-8.3	-6.0	-4.0	2.9	5.8	-6.9	-8.2	-7.8	-10.1	-55.3	-7.9	-52.0	-81.3	-86.0	-89.6	-91.3
Asia-Pacific-LAC	-4.5	-5.6	-0.5	-5.5	-3.1	-9.2	-8.0	-8.1	-5.3	-1.0	-7.7	-8.8	-35.4	-7.8	-64.7	-73.4	-81.4	-83.2	-82.8
Europe-North America	-0.2	2.1	0.8	-0.6	-0.6	-0.5	0.9	1.4	1.4	1.8	0.7	-19.4	-58.5	-5.9	-89.1	-90.9	-93.5	-94.4	-93.2
Asia-Pacific-Middle East	3.4	4.1	4.0	4.0	3.5	3.0	-2.8	-3.5	-3.2	-3.5	-7.9	-18.2	-44.9	-4.7	-75.5	-76.7	-80.4	-84.2	-86.2
Europe-Middle East	3.7	3.1	4.3	3.0	3.0	1.9	1.4	3.1	2.0	1.0	-5.0	-19.1	-52.1	-3.8	-86.0	-86.9	-89.4	-89.7	-90.5
LAC-North America	-0.3	-0.2	-1.8	-1.4	-1.9	-1.5	-1.9	-1.3	-0.9	-1.6	0.1	1.0	-32.1	-3.3	-62.0	-81.5	-91.2	-93.3	-89.9
Africa-Europe	3.2	5.4	2.4	2.7	2.4	3.2	3.4	4.1	3.2	1.4	1.4	-5.6	-51.0	-1.8	-80.8	-87.9	-89.2	-88.3	-87.4
Africa-Middle East	4.7	8.5	7.6	6.9	7.6	6.7	6.9	5.1	5.1	5.9	-1.5	-13.2	-57.5	-0.8	-78.5	-86.4	-86.1	-88.4	-86.6
Europe-LAC	5.7	6.4	4.3	3.3	2.8	2.2	4.3	3.1	3.5	2.5	2.7	-2.2	-44.4	-0.3	-86.8	-92.8	-94.8	-96.8	-95.2
Middle East-North America	6.3	7.3	4.9	4.1	3.8	2.9	2.1	2.6	3.5	3.3	3.4	-5.8	-38.9	-0.1	-82.9	-90.0	-92.4	-91.8	-93.3
Africa-North America	21.5	21.0	15.0	17.5	15.6	17.4	14.1	19.7	20.1	18.5	24.5	12.9	-66.9	11.8	-93.4	-85.2	-92.4	-94.0	-88.5

Figure 4. Year-on-year change in ASKs for international corridors, Q1 2020 vs 219 (above) Year-on-year change in ASKs for international corridors, Jan-Apr 2020 vs 219 (below)
Source: analysis based on OAG.

Concerning airlines, the impact was different depending on the region and type of carrier (Table 2). Full-service network carriers (FSNC) are more exposed to international traffic and most started reducing capacity in the first half of February. African FSNCs did, however, reacted later in March. We need to leave aside the Latin American and Caribbean (LAC) market as it presents a structural reduction of supply during the whole period of analysis due to pre-crisis market dynamics. On the other hand, due to their lower exposure to international traffic, low-

cost carriers (LCC) reduced their supply later. In Asia-Pacific, the decline started from the second half of February, in Europe and the Middle East from mid-March, and in LAC, Africa and North America from the end of March[4].

Table 2. Year on year change in ASKs according to airline type, Jan-Apr 2020 vs 2019.

Low-Cost Carriers W/C	30-Dec	06-Jan	13-Jan	20-Jan	27-Jan	03-Feb	10-Feb	17-Feb	24-Feb	02-Mar	09-Mar	16-Mar	23-Mar	30-Mar	06-Apr	13-Apr	20-Apr	27-Apr
Africa	14.6	16.6	6.8	6.9	10.3	10.6	11.7	12.1	9.0	9.6	9.4	2.8	-43.8	-47.6	-52.6	-50.1	-55.8	-54.0
Asia-Pacific	11.6	13.0	14.0	14.1	13.3	5.5	0.9	-3.1	-4.9	-6.9	-15.6	-18.4	-32.8	-54.6	-62.4	-67.1	-66.9	-67.8
Europe	3.9	0.5	-4.9	-4.9	-4.3	-2.6	-1.3	0.2	0.1	0.6	0.6	-10.6	-54.0	-75.2	-81.2	-84.0	-89.4	-85.3
LAC	8.4	9.7	9.4	10.3	10.9	11.8	12.6	10.8	10.4	14.2	9.1	9.1	-15.2	-52.2	-60.0	-70.5	-79.1	-76.5
Middle East	11.9	13.2	14.0	13.7	13.4	14.9	14.6	14.8	14.3	15.2	8.8	-19.9	-46.0	-54.8	-58.1	-50.7	-64.7	-64.6
North America	1.7	-0.2	-0.3	-0.6	0.5	0.2	0.4	0.3	0.5	-1.3	0.4	0.7	-6.0	-16.1	-37.1	-54.1	-56.6	-58.3

Full-Service Carriers W/C	30-Dec	06-Jan	13-Jan	20-Jan	27-Jan	03-Feb	10-Feb	17-Feb	24-Feb	02-Mar	09-Mar	16-Mar	23-Mar	30-Mar	06-Apr	13-Apr	20-Apr	27-Apr
Africa	3.9	5.3	4.2	4.3	3.5	2.9	1.8	2.4	2.2	0.4	-1.9	-8.6	-51.1	-81.1	-86.3	-89.6	-88.3	-86.2
Asia-Pacific	3.4	4.2	5.3	3.1	1.5	-8.5	-30.8	-35.2	-33.3	-28.2	-32.8	-34.5	-48.5	-67.4	-72.1	-72.0	-73.3	-71.4
Europe	0.7	1.7	1.3	0.6	0.5	-0.1	-2.1	-2.4	-3.1	-4.2	-8.3	-20.3	-57.1	-83.0	-89.9	-91.8	-93.0	-90.4
LAC	-1.7	-1.3	-2.2	-2.6	-2.4	-2.6	-2.1	-1.7	-1.6	-1.4	-1.0	-1.8	-38.1	-71.9	-88.4	-92.1	-93.5	-89.0
Middle East	1.7	1.8	1.9	1.1	1.3	0.3	-2.4	-1.8	-1.8	-2.6	-7.6	-17.6	-48.7	-78.5	-81.0	-82.4	-83.7	-86.7
North America	3.9	3.9	3.0	2.6	2.9	2.6	-0.9	-1.3	-2.2	-3.5	-3.9	-6.7	-24.9	-54.7	-73.9	-80.8	-83.1	-83.1

Source: analysis based on OAG

Air cargo, on the other hand, has been vindicated by the Covid-19 crisis (Figure 5). Shipments of food and medical supplies have been protected by governments to ensure the supply of basic necessities. Thus, even though air freight tons quickly dropped in Asia Pacific in late January, a partial V-shaped recovery pattern was observed soon after. Later, freight tones progressively decreased from the beginning of March in Europe, North America and the Middle East. Table 3 and Figure 6 show that the reduction was not homogeneous across the different corridors and directions. Clearly the corridor from Asia Pacific to North America had the major disruption while the traffic in the opposite direction was certainly more resilient.

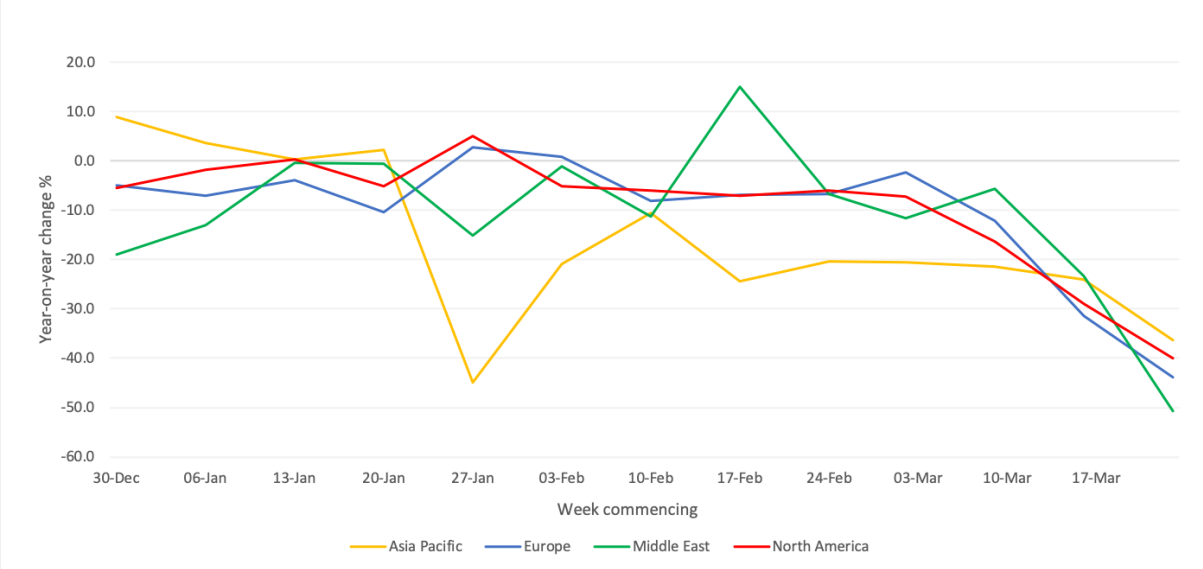


Figure 5. Year-on-year change in air freight chargeable weight (tonnes), Q1 2020 vs Q1 2012. Source: CLIVE Data Services.

Table 3 Year-on-year change (%) in air freight capacity according to origin and destination, Q1 2020.

Origin \ Destination	Asia Pacific	Europe	Middle East	North America
Asia Pacific	-	-23.5	-12.1	-40.0
Europe	-22.0	-	-8.4	-6.1
Middle East	-14.8	-4.1	-	-8.1
North America	-4.0	-3.9	-0.7	-

Source: CLIVE Data Services.

[4] European LCCs reduced their ASK production from mid-January to mid-February 2020, but this was related to planned capacity adjustments.

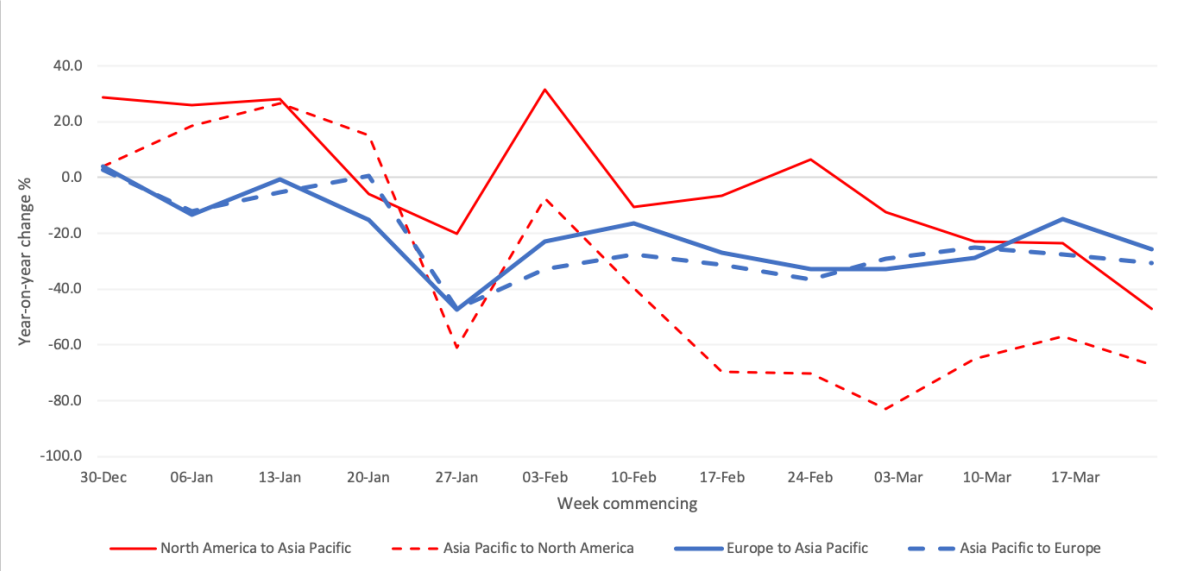


Figure 6. Year-on-year change (%) in air freight capacity, corridor directionality, Q1 2020 vs Q1 2012. Source: CLIVE Data Services.

4. Supply-side: the long-term consequences

There was agreement among the interviewees that there will be a trend towards consolidation in supply, especially in the European market. One of the major concerns expressed by the interviewees was related to ensuring a level playing-field after the foreseeable round of state aid to major carriers. This comes with important worries. First, state aid could extend the life of airlines that in a context free of Covid-19 would have disappeared. Second, state support is likely to take different forms, in the absence of a common European policy on the matter. Third, a few interviewees dreaded the implications of states becoming shareholders and exerting influence on airline management that could take the industry 20 or 30 years into the past.

Full-service network carriers (FSNC) were seen as the major losers in the medium and long term. First, the slow recovery and the lower traffic levels expected across the industry can ease congestion levels in major European hubs and would allow the entry of new competitors, especially low-cost carriers, threatening some of the European fortress hubs[5]. Increased competition in short-haul routes would potentially erode the capacity of FSNCs of sustaining a hub-and-spoke operation and therefore the lucrative long-haul flights. Second, given that travel bans and restrictions are set at the national level, there is a common understanding that international and intercontinental flights will be the last to be re-established. This creates a problem to airlines operating hubs with very limited proportions of domestic or short-haul feeding. In other words, sixth-freedom hubs can be highly affected, and some interviewers highlighted the challenging future of British Airways, KLM and Emirates in their respective hubs at London Heathrow, Amsterdam and Dubai. In this context, the interviewees agree that FSNCs will make adjustments to capacity by downgauging the fleet, which can be done by getting rid of larger and older wide-body aircraft like the B747 (cita a noticia), making a more extensive use of narrow-body aircraft for long-haul markets or working together with regional airlines to have a feeding fleet more appropriate for thinner markets.

[5] A fortress hub is the dominance of a single FSNC carrier at an airport. Whilst carriers may be competing head-to-head for traffic between non-hub cities via their respective hubs, they have a local monopoly in the spoke segments from their respective hubs to other cities in the networks (Zhang, 1996; Hudson and Butler, 1988).

Regarding the latter, two interviewees predicted that regional airlines will clearly benefit from increasing their activity as hub feeders during the recovery period. This would, indeed, take the regional airline business model in Europe closer to the US model (Brueckner and Pai, 2009; Dresner et al., 2002). Regional airlines could also benefit from a potential increase of Public Service Obligations (PSOs) by governments, since this is an existing mechanism that would help keeping the level of supply at an acceptable level if the recovery of demand is weak.

Concerning low-cost carriers (LCC), the general perspective of interviewees was that, in the post-Covid-19 era, these airlines will focus on the larger markets and abandon the smaller ones. In that regard, many interviewees highlighted the high probability of LCCs moving into large hub airports. However, some indicated that lower congestion would prompt LCCs to reduce daily frequencies in large European city-pairs, as the high daily frequency strategy was partly used to internalise delays and cancelations[6].

The changes mentioned above can have a direct impact on the airport business. First, interviewees considered that regional airports would be the big losers of this crisis as demand levels would be overall lower and capacity would be freed up in larger markets. Second, medium-size airports with a distinct leisure profile would face stronger competition from other leisure markets that can offer more competitive prices and lower travel restrictions. In that regard, one interviewee highlighted that airline incentives would be key to recover traffic (see next section) as airports would come out of this crisis with a worst negotiating position in front of airlines. Thirdly, airports hosting an airline hub could be the strongest survivors in terms of passenger numbers, with the caveat that survival will be also accompanied of potential massive changes in the competitive landscape with the potential entry of LCCs and a great reduction of hub operations. A combination that would bring about a more unstable market situation. Fourth, large non-hub airports with a significant level of intercontinental traffic, resulting from hub-bypassing strategies, are a question mark for our interviewees. Hub-bypassing is an airline strategy taking advantage of the economic growth of non-hub regions with the introduction of more efficient long-haul airliners that directly feed the foreign airline's hub avoiding congestion at European hubs (Suau-Sanchez et al., 2016a,b; Tembleque-Vilalta and Suau-Sanchez, 2016). The difficulty that our interviewees have assessing these cases comes from two contradictory dynamics. On the one hand, there is a general agreement that the most efficient narrow-body aircraft, which are used for hub-bypassing, will be indeed useful to airlines for the recovery of long-haul traffic. On the other hand, the lower traffic levels, the potential entry of new competitors at hub airports, the late recovery of long-haul demand and the reduction of feeding traffic, all point towards an increasing focus on primary hub airports.

5. Demand-side: Long-term changes of behaviour

Overall, our interviewees seem to agree that demand will be highly affected, not only in the short and medium term, but also in the long term, especially because of weakened demand and lower levels of disposable income, but also due to changes in behaviour.

5.1 The business traveller

The interviewees perspective is that business travel will recover in the short term in order to sustain relationships with clients and providers. However, MICE (Meetings, Incentives, Conferencing, Exhibitions)-related travel will take significantly longer to recover because most of events have been postponed and the marketing and travel budgets of companies will be

[6] The mechanisms to internalise congestion have been largely studied. See, for example, Bendinelli et al. (2016) and Brueckner (2002, 2005).

significantly reduced for the coming few years. Therefore, although MICE travel may return, the size of the teams sent to events might be smaller.

Many expressed their concern for business-related long-haul travel, which is known for sustaining FNSCs through the generation of density economies (Brueckner and Spiller, 1991; Caves et al., 1984). In this regard, some interviewees think that long-haul flights will be the last to recover. The reasons considered by the interviewees are mostly related to the expected uneven lift of travel bans and reconnection of countries to the international travel markets.

There is also a serious concern about the long-term impact of the acquired teleworking skills during lockdown and the investments made by companies in collaboration with workplace platforms. The interviewees think that, whilst not likely having a radical effect, it may indeed reduce the propensity to fly of executives, especially for meetings with staff members of the same company, in which relationships and trust already exist. Some argued that, even if the impact in the reduction of business travel were as small as 5% or 10%, that would be enough to impact airlines, as this type of travellers generate high yields. In relation to this, previous research has shown that the impact of videoconferencing on business air travel is very limited and does not represent a threat to the airline industry (Denstaldli, 2004) or it could even show a positive relationship for those business people who travel a lot (Denstaldli et al., 2013). Nonetheless, videoconferencing cannot be analysed as independent element in the current context of digital transformation (Schwarzmüller et al., 2018). Indeed, the extensive implementation of cloud applications might potentially have a higher impact than traditional videoconferencing. The integration of these technologies may enable companies to minimise face-to-face contact among their staff and maximise the value of virtual mobility (Faulconbridge et al., 2009).

5.2 The leisure traveller

The general view was that the impact of Covid-19 would be less intense for the leisure passenger and that we would see a quicker recovery of demand compared to the business travellers.

Nevertheless, one of the airport representatives highlighted that the support from cities, regions and tourism authorities in form of marketing aid would become essential to help airlines restarting tourism-related air services in a context of weakened demand. One of the airline executives considered that low fares by themselves would not necessarily ensure a recovery in ticket sales. Most of the interviewees think that although leisure demand might recover earlier than business demand, the reduced disposable income would make consumers travel less. In this regard, traditional "sun-and-beach" destinations in Southern Europe may lose visitors to more affordable destinations in the north of Africa or the east of the Mediterranean.

Health concerns were also considered to play a more important role for the return of leisure demand than business demand. Business travel is usually not a personal election, but leisure travel may involve various family members with different levels of risk in relation to the Covid-19 and would certainly involve a more complex decision-making process. A few interviewees noted the possible rise in staycations[7] beyond 2020 and 2021.

[7] A staycation is a period in which an individual or family stays home and participates in leisure activities within driving distance of their home and does not require overnight accommodations. Alternatively, it is a holiday spent in one's home country rather than abroad.

For both business and leisure travel, the interviewees are concerned about the lack of consumer confidence when flights resume. Besides fear and health concerns, lower levels of disposable income in households and saving measures in surviving businesses. In that regard, two of the interviewees suggested that support to airlines might not be enough to stimulate demand. This remark was made in relation to the IMF World Economic Forum preliminary report published in early April (IMF, 2020). According to Baldwin and Weder di Mauro (2020), to avoid a persistent weak demand, a "whatever it takes" approach might be required, including subsidies for households and workers until reaching a partial recovery. Others, like Krugman (2020), advocate for a policy of permanent stimulus.

6. Regulation: relaxation or tightening?

The most immediate regulatory concern of the industry was slot regulation, as during the first days airlines flew empty aircraft to make sure they kept the slots for the following season[8] (cita noticia). This was a short-term concern that was quickly resolved with a suspension of the slot rules by the EU from March 1st to October 24th, 2020. Interviewees considered that, given the expansion and advance of the crisis, there were other regulatory aspects of importance.

Covid-19 is expected to bring more heath screening at airports, which could take different forms, such as temperature checks or even quick antibody tests for Covid-19 when these can be produced at an affordable price and are reliable enough. In any case, these controls will require capital expenditure, human resources and terminal space, which could translate into new airport fees. Others also mentioned possible restrictions for passengers of particular regions, which would affect traffic rights.

Concerning social distancing, the point of view of the experts was also quite similar. Whilst it could be applied to airports, with a significant reduction of terminal capacity[9], its implementation in the airliner cabin would not be feasible from a commercial point view, as load factors would be lower than 50%. The policy of some airlines of offering an empty middle seat was seen by our interviewees more as a way of selling "peace of mind" to passengers and a potential source of ancillary revenues, rather than an effective measure of social distancing.

The experts mostly agreed that the EC would not back down in relation to the EU ETS and the EU Green Deal, in view of the strong statement by the EC President in that regard (Euroactiv, 2020). A few interviewees had more concrete concerns regarding sustainability, that is how CORSIA baseline emissions, which were calculated based on the years 2019 and 2020, would be calculated now given the massive drop in airline activity. Also, whether the start of CORSIA would be compromised in 2021 and what would happen with the progress of aviation from Phase 3 to Phase 4 of the EU ETS in 2021.[10] One of them also highlighted that state aid and the potential entry of states in airlines as shareholders could be an opportunity to impose green conditions to state aid. Indeed, several weeks after the interview, the French finance minister stated that bailout of Air France would entail the reduction of domestic flights of less than 2.5h that have a rail alternative and do not contribute to connecting traffic (Flightglobal, 2020).

[8] The use it or lose it rule or grandfather rights establishes that if a series of slots (≥5) are used in the previous equivalent season for at least 80% of the time, the incumbent carrier has the right to use those slots in the next season.

[9] Simulations based on IATA ADRM by Flare Consulting estimate that social distancing measures in airports would be translated in an overall terminal capacity reduction of 70%.

[10] Phase 3 (2013-2020) of the EU ETS is linked to the Kyoto agreement and the reduction of annual allowances did not apply to aviation. Phase 4 (2021-2030) is linked to the Paris agreement and the cap of aviation emissions becomes subject to the annual reductions.

A few interviewers also saw an opportunity to relax airline foreign ownership regulations, which would allow surviving airlines to operate in different jurisdictions. But state intervention makes this an unlikely scenario. In spite of that, the overall trend towards deregulation should continue it has proven beneficial in may areas (need paper citation).

7 The major unknowns

The first major uncertainty was the future development of air freight. On the one hand, some considered that Covid-19 would accelerate the process of greater orientation towards cargo that many airports were already going through as part of the growing importance of e-commerce. Indeed, integrated express carriers (e.g., UPS, FedEx, DHL) would be the great winners and the return of industry from China and Southeast Asia back to Europe and North America would not be that significant, as some mass technology producers (e.g., Foxconn) are very difficult to replicate in those regions. On the other hand, increasing regionalisation would mean that air cargo may decrease in favour to other modes except for a few key sectors like pharma, technology and perishables.

The other big question mark for experts was future ticket prices. Some argued that prices would generally increase as a result of an excess of supply and that a smaller pool of passengers would have to cover the costs of an industry that would be too large, particularly in the segment of business travellers. On the contrary, the excess of supply would lead to lower ticket prices and that in any case the industry would do significant capacity adjustments to match demand levels, which would keep prices at a levels similar to the recent past. One interviewee mentioned that the lower costs of aircraft leasing and fuel (oil price plummeted during the first quarter of 2020) would certainly allow airlines to offer lower ticket prices. LCCs would become very aggressive in their pricing to stimulate demand, which may not necessarily be effective as demand would be weakened due to lower levels of disposable income and fear to fly (IATA, 2020b).

8. Opportunities to transform the aviation industry

Some interviewees highlighted the opportunities of this crisis to transform some ethical aspects of the aviation industry.

Two experts asserted that the industry had probably grown beyond its limits and that there were aspects that needed to be reconsidered, not only by the industry, but also from consumers. For example, food consumption had to be rethought as air cargo was artificially sustained by an industry of food perishables catering to customers demanding exotic fruits all year round. Indeed, the sustainability of exporting time-sensitive perishable and exotic products requires of complex supply chains and high transportation costs (Vega, 2008). This is not a new concern. Indeed, supporters of degrowth have asked for a long time to consider throughput-related variables for socially sustainable degrowth, including for the transport and the distribution of goods and food (Kallis, 2011). Recent methods to implement sustainable business models ask for encompassing indicators of the main four dimensions of sustainability, which are operational, social, economic and environmental, respectively (Janic, 2003). Balanced sustainable strategies are needed to be ethically sound (Walker and Cook, 2009), along with the incorporation of all stakeholders as part of the solution when implementing sustainable business models (Amaeshi and Crane, 2006), as well as all the four dimensional indicators (Janic, 2004).

The second ethical aspect that was highlighted was the application of the EU regulation 261/2004 on air passenger rights. As a result of the mass cancellations, airlines opted for

offering vouchers for subsequent use as a way to protect their financial situation and avoid and imminent bankruptcy. In light of the situation, on March 18th 2020, the EC published a communication (EC, 2020) providing guidelines on the interpretation of the EU passenger rights regulations in the context of Covid-19. In case of cancellations, the transport provider must reimburse or re-route the passengers. If passengers themselves decided to cancel their journeys, reimbursement of the ticket depends on its type, and companies had to offer vouchers for subsequent use. However, the guidelines and regulations were not followed and in April, twelve governments[11] urged the EC to suspend rules forcing airlines to offer full refunds instead of vouchers for future travel (Euronews, 2020). The interviewees expressed very different views in this regard, but those believing that regulations had to be upheld considered that the short-term survival needs of the industry had been placed above ethical business principles, even when actually short-term support may be wasteful or even detrimental in terms of reputation for the really important task of long-term reconstruction of the industry. In that regard, reputational issues are difficult to gain and easy to lose, and need a long-term sustainability strategy based on stakeholder engagement (Amaeshi and Crane, 2006). Future strategies understand that sustainability in aviation sector is socially embedded so, need to understand the logic behind all stakeholders, and ethical issues that would put the industry at stake because it is not seen as ethically sound as it should be (Payán-Sánchez, et al., 2018). At the same time, the literature on sustainable business models agrees that sustainability would be possibly generated if justice is incorporated, which implies all stakeholders receive in accordance of their contributions (Cugueró-Escofet and Rosanas, 2020)

9. Conclusions

This paper presents a first approach to the impact of Covid-19 on commercial aviation. We have provided a portrait of the shock by looking into airline seat capacity and air freight demand for the first four months of 2020. The data provides context for an assessment of the long-term impact of Covid-19, according to the views of a sample of senior aviation executives.

The interviews have revealed some serious long-term consequences for the air transport supply. First, the interviewees considered the crisis would lead to consolidation and a significantly smaller industry in terms of size. Second, they were concerned about the possible differences in terms of state aid and how that could affect the level playing field in a post-Covid-19 aviation market. Third, FSNCs were seen as the major losers since the recovery in international markets will be slower and they may face new competition with the potential entry of new airlines in their home hub markets. Airlines that have built their hubs mainly on sixth-freedom traffic, like British Airways, KLM, Emirates and Singapore Airlines, were identified as the weakest in terms of recovery potential. Fourth, regional airlines were identified as possible short-term winners during the recovery period, as they could potentially help FSNCs adjusting their feeding capacity, and also benefit from a possible increase in the use of PSOs. Fifth, LCCs are expected to concentrate in primary markets with the possible entry in hub airports, and a general reduction in frequencies at the route level. Seventh, in terms of winning and losing airports, regional and secondary airports would be the big losers as capacity would be freed up in larger markets, which would attract airlines. On the contrary, large airports hosting a hub could reinforce their leadership by attracting new airlines, which would secure traffic volumes but also bring about a more competitive and aggressive marketplace.

[11] The twelve governments were: Belgium, Bulgaria, Cyprus, Czech Republic, Estonia, France, Germany Greece, Ireland, Latvia, Malta, Netherlands, Poland and Portugal, Romania and Spain.

Experts were concerned about the recovery of business travel, mainly due to the cancellation of MICE events, and the uneven lift of travel bans and reconnection of countries to global trade networks. Teleworking was seen as serious threat to recovery, as the current context of digital transformation and cloud applications offer better solutions for teleworking than traditional videoconference. On the other hand, the recuperation of the leisure passenger segment was expected to be quicker, but reduced disposable incomes would curtail propensity to fly and require of significant support, probably in terms of route subsidies and marketing aid, but also with direct demand stimulus. Finally, fear and health concerns were identified as major issues for the leisure traveller, more son than for the business traveller.

Regarding regulatory aspects, all interviews considered that new health screening controls would be imposed at airports, translating in higher costs for airlines and passengers. But, they did not consider social distancing as a viable commercial option for airlines. Environmental regulation were not expected to be relaxed and some saw state aid as an opportunity to impose more environmental restrictions on airline operations.

On a positive note, the interviewees identified a couple of areas in which the industry could be transformed towards a more ethical business. Firstly, in relation to supply chains and responsible consumption. Secondly, improving the long-term reputation of the industry by respecting customer rights as stated in the regulations.

The results of this paper represent an early assessment that can help the aviation industry and other related industries like tourism in the preparation for the recovery period. Future research could focus on many areas. First, reassessing industry expert views during the recovery period. Second, analysing in detail the changes in the supply. For example, identifying the structural changes in airline networks or the effects of consolidation processes. Third, studying in detail the behaviour of demand with regards to teleworking and digital transition in the workplace. Fourth, examine the unsolved ethical and reputational issues of the industry, which are needed to evolve the current business models into more sustainable models in the long-term.

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